

Application No. 10/564,735 – Amendment filed August 18, 2009

REMARKS

Claims 1 to 34 remain in the case. Reconsideration in view of the following remarks and entry of the foregoing amendments are respectfully requested.

Claim 16 has been amended in view of the Office Action and to better define what Applicants consider their invention, as fully supported by an enabling disclosure. In particular, claim 16 has been amended to clarify the nature of the gas produced. Support for this amendment can be found, for example, at paragraphs [0017] and [0037] of the specification as filed. No new matter has been entered by the foregoing amendment.

REJECTION UNDER 35 U.S.C. § 103

Claims 1-34 have been rejected under 35 U.S.C. § 103(a) as being obvious in view of International Publication Number 97/46724 by Lalancette *et al.* [hereinafter WO '724], Canadian Patent Number 2,193,783 by Lalancette *et al.* [hereinafter CA '783], International Publication Number 02/053788 [hereinafter WO '788] by Lalancette *et al.*, and "A study of chromite carbochlorination kinetics" by Kanari *et al.* [hereinafter *Kanari*].

Applicant respectfully traverses as follows.

WO '724 teaches the chlorination of chromite ores for obtaining chromium enriched chromite. The process comprises the steps of dry chlorinating the ores at a temperature between 400°C and 750°C in the presence of NaCl to produce a chlorinated substrate containing hematite (Fe₂O₃), i.e. a solid, and acid insoluble chromium enriched chromite (page 4, lines 1-8; page 11, lines 7-9; and page 12, lines 1-4). In order to extract the Fe from the hematite, a high amount of hydrochloric acid must be used and the chromium enriched chromite is recovered.

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CA '783 teaches the chlorination of chromites ore for the extraction of platinum group metal (PGM). The method involves mixing the ore with NaCl 10% wt/wt, dry chlorination of the mixture between 350°C to 800°C with gaseous chlorine thereby producing hematite (i.e. a solid). Extraction of PGM from the hematite is obtained by washing the hematite with a concentrated hydrochloric acid solution, and filtering and recovering the PGM from the solution. PGM recoveries are reported to be in the order of 95 to 100%.

The Examiner appears to believe that CA '783 and WO '724 teach the formation of FeCl_3 during chlorination. In particular, the Examiner refers to Fig. 1 of WO '724 and CA '293, which, according to the Examiner, shows "that volatiles of the form M_yCl_y are removed from the dry chlorinator and condensed and FeCl_3 was recovered in the condenser as acid soluble ferric chloride, which suggests that gaseous (volatile FeCl_3) was formed during the reaction of chromite ore with Cl_2 " (emphasis added, page 10, second paragraph and page 16, first paragraph of the current Office Action). With respect, Applicants submit that the Examiner is mistaken in his interpretation of the cited references.

The only FeCl_3 that is produced in the WO '724 and CA '783 is during the chlorine neutralization step (removal of chlorine from the various gases that are produced). FeCl_3 is not produced during the process of extraction/chlorination (i.e. reaction of chromite ore with Cl_2) but only in the scrubbing step which allows for neutralization of chlorine. In the '724 and '783 chlorination reaction, iron oxide is extracted as hematite (see for instance page 4, lines 4-14 of WO '724). In fact, FeCl_3 is only produced in the presence of CO which prevents the formation of hematite (see paragraph [0018] of the application to this effect). It is impossible to produce FeCl_3 while at the same time producing hematite.

The prior art teaches away from using carbochlorination to extract PGM from chromites.

As admitted by the Examiner, none of CA '783, WO '724 and WO '788 describes or suggests using CO. They all describe chlorination techniques. Although

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Kanari suggests using CO to increase Cr/Fe, it also teaches that this technique provokes the volatilization of chloride compounds in the presence of FeCl_3 .

As explained at paragraph [0019] of the specification:

“A bibliographic study realized by Kanari, Ph. D. thesis Polytechnic Institut of Lorraine, 1995, on the formation of gaseous chlorides demonstrated that some chloride compounds are transported at temperatures where their partial vapor pressure is near zero. These materials contained Al and Fe compounds. It is well known that a transport involving gaseous iron chlorides or aluminum chlorides is at the origin of this phenomenon. Iron chlorides and aluminum chlorides can form, with chlorides of other metals, compounds of the type $\text{M}_x\text{N}_y\text{Cl}_z$ (M= rare earths, precious metals, or base metals, etc. N= Fe, Al, Ga or In). **Kanari 1995, reported a complete list of references involving the formation of $\text{M}_x\text{N}_y\text{Cl}_z$ compounds. It is clear that chloride compounds can be volatilized at low temperature in the presence of FeCl_3 or AlCl_3 . Prior to the present invention, it was believed therefore [that] any metals including all PGM species would be volatilized with FeCl_3 during carbochlorination of chromites**”. [Emphasis added]

The Examiner stated that:

"In response, Applicants are inferring that Kanari volatilizes PGM metals yet *Kanari does not explicitly teach that this happens and the strength of this line of reasoning is tied to the strength of the Examiner's own logic in asserting that the PGM chlorides are retained in solid form per the teachings of the CA '783*. As for the retention of PGM chlorides being highly unexpected, this is unconvincing given the teachings of CA '783 dissolution of PGM chlorides after chlorination and Kanari's teaching as to using carbochlorination to better upgrade chromite iron and more efficiently remove iron as FeCl_3 ." [Emphasis added] (Page 17, fourth paragraph of the Office Action).

Applicant understands that the Examiner does not believe that the above-cited extract of the instant specification clearly suggests that PGMs would be volatilized in the presence of FeCl_3 . The following references more clearly describe the volatilization of PGMs in carbochlorination.

Hence Rivarola *et al.*, 1981, enclosed in the IDS initialed by the Examiner on June 2, 2008, disclosed that the use of carbochlorination to extract PGMs from spent catalysts resulted in the volatilization of PGMs as summarized in the instant specification:

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"The effect of carbochlorination on PGM values contained in spent automotive catalyst is described in the prior art. Rivarola *et al.*, 1981, Lat. am. j. chem. eng. appl. chem., 11, 47-52, describe the volatilization of platinum from Al_2O_3 spent catalyst by a chlorine-carbon monoxide mixture. The recovery of platinum, *as a volatilized phase*, yielded extraction closed [sic] to 100 %." [Emphasis added] (see paragraph [0007] of the instant specification).

See also from Rivarola *et al.*:

"The reacting gases get into the reactor through the upper part coming from the feeding system, which consists of the gas tubes with their respective flow and pressure meter. *The reacting products get out through the lower part of the reactor, and they condense there a great part of the platinum compounds*, the rest being kept at a washing trap with a hydrochloric acid solution at 12.5% in volume." [Emphasis added] (See page 48, right hand column, paragraph under heading "Experimental" of Rivarola *et al.*);

and,

"Due to the preceding difficulties, the chlorine reacting gas was substituted by the chlorine-carbon monoxide mixture in equal volumes as the existence of chlorine carbonyl platinum complexes, **which sublimate at low temperature, is known** (Cotton and Wilkinson, 1974)." [Emphasis added] (see p. 49, Section 3.2 of Rivarola *et al.*).

Kim *et al.*, 2000 also enclosed in the IDS initiated by the Examiner on June 2, 2008, disclosed that the use of carbochlorination to extract PGMs from spent catalysts resulted in the volatilization of PGMs:

"After the required amount of spent automotive catalyst was introduced into the reactor, it was heated in a N_2 atmosphere until the desired temperature was reached. After the removal of moisture in the sample for 1 h, the reactant gases (CO and Cl_2) were introduced to the reaction zone for the predetermined reaction time. Then, the reactor system was cooled to ambient temperature in a N_2 atmosphere. *The volatile **PGM chlorides** and/or carbonyl chlorides and other volatile elements were separated from the exhaust gas by their condensation on the reactor wall and condenser wall.*" [Emphasis added] (See page 1186, left hand column, last paragraph).

These references were the closest known prior art to the methods of the present invention and suggested that a major portion of PGMs would volatilize during carbochlorination.

Referring to the Examiner's logic stated in the Office Action excerpt presented above, it may well be that CA '783 teaches that PGM chlorides are

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retained in solid form but CA '783 does not teach a carbochlorination technique but a chlorination technique. As stated above, a chlorination technique does not produce gaseous FeCl_3 . It could not be predicted from CA '783 what would be the effect of carbochlorination on PGMs. Furthermore, in view of Kanari, Rivarola *et al.* and Kim *et al.* described above, it would have been expected that PGMs would be volatilized. These references teach away from using carbochlorination to extract PGMs from chromites. Applicants therefore respectfully submit that a combination of the cited references does not render the instant claims obvious.

Unpredictable advantage of carbochlorinating chromites

As indicated in the application, the presence of CO results in the formation of a catalytic melt, a NaCl-FeCl_3 system containing NaFeCl_4 , which contributes to the production of a solid material containing metallic salts of PGM (see for instance paragraph [0029] at pages 7 and 8, paragraph [0059] at page 15 and paragraph [0063] at page 16).

The formation of NaFeCl_4 does not occur in the absence of CO. The chlorination processes of the prior art therefore could not teach or suggest the formation and advantage of the presence of NaFeCl_4 in the retention of PGMs in a solid form. The inventors have discovered that this catalyst is a lot more efficient as a reductive agent than carbon.

The rejections of the claims are believed to have been overcome by the present amendments and remarks. From the foregoing, further and favorable action in the form of a Notice of Allowance is believed to be next in order, and such an action is earnestly solicited.

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PETITION FOR THREE (3) MONTHS EXTENSION OF TIME

Applicants hereby request that the period for responding to the Office Action dated February 20, 2009, and originally set to expire May 20, 2009, be extended by three (3) months, so as to expire on August 20, 2009.

The Commissioner is authorized to charge the amount of \$555, to cover the three-month extension herein requested, to Deposit Account No.07-1509. The Commissioner is further authorized to charge any deficiencies or to credit any overcharges to this same Deposit Account number.

Favourable action on this request for extension of time is courteously solicited.

Authorization is hereby given to charge Deposit Account no. 07-1509 for any deficiencies or overages in connection with this response.

Respectfully submitted,

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Date: August 18, 2009

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